TECHNICAL WHITE PAPER

Sub-5 ps Precision for Time-Resolved Science

How CERN PicoTDC technology unlocks new frontiers in imaging, quantum science, and ultrafast detection with ASI Timepix3 detectors

Amsterdam Scientific Instruments · Boris van Wessel & PicoTDC Team · April 2026

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ABSTRACT

Precise timing is the cornerstone of modern time-resolved science. From disentangling femtosecond molecular dynamics to resolving single-photon coincidences in quantum optics experiments, the ability to timestamp detector events at picosecond precision transforms raw data into physical insight. This white paper introduces the CERN PicoTDC, a 64-channel time-to-digital converter CHIP implemented in 65 nm CMOS, delivering a single-shot RMS resolution of 3.3 ps and sustained readout rates up to 320 Mhit/s per channel. Licensed to Amsterdam Scientific Instruments (ASI), PicoTDC is integrated across the ASI Timepix3-based detector portfolio, including LynX (X-ray), Chronos (optical/ions/neutrons), CheeTah (TEM), and FeliS (SEM), enabling a new tier of timing performance for demanding scientific instrumentation.

This document surveys the principal application domains that benefit from sub-5 ps timing: Velocity Map Imaging (VMI), Ultrafast Transmission Electron Microscopy (UTEM), Imaging Mass Spectrometry, Time-Resolved X-ray Photoelectron Spectroscopy (TR-XPS), Fluorescence Lifetime Imaging (FLIM), quantum optics (Hong-Ou-Mandel interference, Quantum Key Distribution (QKD), neutron time-of-flight, and COLTRIMS (cold target recoil-ion momentum spectroscopy). For each domain, the paper describes the measurement challenge, the role of the Timepix3 detector, and the specific advantage conferred by PicoTDC-grade timing resolution.

KEYWORDS: *time-to-digital converter, picosecond timing, Timepix3, PicoTDC, time-resolved imaging, quantum optics, VMI, FLIM, ultrafast electron microscopy*

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1. Introduction

1.1 Background: The Timing Frontier in Scientific Instrumentation

Time is the hidden dimension of modern experimental science. Whether tracking the sub-femtosecond rearrangement of electrons in a photoexcited molecule, resolving the quantum indistinguishability of single photons, or mapping the three-dimensional momentum distribution of ions ejected from a breaking chemical bond, the precision with which one can assign a timestamp to a detector event defines the boundaries of what can be measured.

Conventional time-to-digital converter (TDC) technology, including FPGA-based solutions and the widely-used HPTDC chip from CERN, has served scientific instrumentation well for decades, delivering timing resolutions in the range of 100–500 ps. Yet a new generation of experiments demands an order of magnitude more. Pump-probe studies at free-electron laser facilities require timing synchronisation at the few-picosecond level. Hong-Ou-Mandel (HOM) interference experiments depend on coincidence resolution windows of tens of picoseconds to observe photon bunching. Velocity map imaging (VMI) systems benefit directly from sharper time-of-flight discrimination to disentangle overlapping ion or electron momentum channels.

The CERN PicoTDC is the successor to the HPTDC and developed within CERN's EP (Experimental Physics) department. PicoTDC addresses this gap directly. With a single-shot RMS resolution of 3.3 ps, a bin size of 3.05 ps, and a sustained per-channel readout rate of up to 320 Mhit/s, it brings High Energy Physics-grade timing precision to laboratory-scale instrumentation for the first time in a compact, licensable CHIP package.

Amsterdam Scientific Instruments (ASI) has licensed PicoTDC technology from CERN and integrates it across its Timepix3-based hybrid pixel detector product family. This combination of a world-class position-sensitive time-resolving detector with state-of-the-art external timing provides scientists with a uniquely powerful platform for a broad range of time-resolved measurements.

1.2 Scope of This Document

This white paper addresses the following topics:

- The architecture and key specifications of the CERN PicoTDC CHIP
- Integration of PicoTDC with ASI's Timepix3-based detector portfolio
- A survey of major application domains in time-resolved science, with emphasis on the specific timing challenges each domain presents and how PicoTDC helps to resolves them
- A consolidated application–product matrix for rapid reference
- Representative performance data demonstrating measured timing jitter

2. PicoTDC: Architecture and Key Specifications

2.1 CERN Heritage and Technology Lineage

PicoTDC was designed by CERN's EP-ESE (Electronic Systems for Experiments) group and published in JINST in 2023 [1]. It is the spiritual and technical successor to the HPTDC (High Performance Time to Digital Converter), which has been the workhorse of particle physics time-of-flight systems for over two decades. PicoTDC is implemented in a 65 nm CMOS process, the same technology node used in many LHC front-end CHIPs. PicoTDC has been produced at scale (20,000 chips) in a 400-pin plastic BGA package weighing just 25 milligrams [2].

The chip's timing interpolator is based on a Delay Locked Loop (DLL) driven by a 1.28 GHz internal clock, itself derived from a 40 MHz reference by a low-jitter LC-based PLL – the same reference frequency used by all LHC experiments. The architecture supports leading edge, trailing edge, or pulse-width capture modes, making it versatile across detector technologies from MCP tapouts to avalanche photodiodes.

CERN has made PicoTDC available through its Knowledge Transfer programme, enabling commercial licensees such as ASI to incorporate it into scientific instrumentation outside the high-energy physics context. A comprehensive technology brief and chip description are available on the CERN PicoTDC website [3].

2.2 PicoTDC Key Performance Parameters

Table 1 summarises the principal specifications of the PicoTDC chip.

Parameter	Value	Notes
Channels	64	Independent, simultaneous
Bin size	3.05 ps	Fixed interpolation step
Single-shot RMS resolution	3.3 ps	Measured across all 64 channels, full dynamic range
Best-channel RMS resolution	1.35 ps	With on-chip per-channel calibration
Dead time per channel	1.5625 ns	Minimum inter-hit interval
Burst rate (per channel)	1.2 GHz	Peak hit rate
Sustained readout rate	80–320 Mhit/s	Configurable 1–4 readout ports
Total readout bandwidth	Up to 10 Gbps	4 × byte-wise readout ports
Edge modes	Rising, Falling, Width	Programmable per channel

Parameter	Value	Notes
Reference clock	40 MHz (external)	LHC-standard; PLL to 1.28 GHz internal
Process node	65 nm CMOS	Packaged in 400-pin plastic BGA
Package mass	25 mg	Suitable for space-constrained instruments

Table 1. PicoTDC key specifications (source: CERN EP-News [2], JINST 2023 [1])

The combination of sub-5 ps single-shot resolution with high channel count (64) and sustained throughput (320 Mhit/s) is unprecedented in a commercial-grade chip. Previous solutions required either sacrificing resolution for throughput (FPGA TDCs) or sacrificing throughput for resolution (single-channel photon timing units). PicoTDC eliminates this trade-off.

2.3 Integration with ASI Timepix3 Detectors

ASI's Timepix3-based detectors already deliver per-pixel timestamps in time bins of 1.56 ns in data-driven mode. This on-chip timing is excellent for resolving events within the detector frame. However, many experiments also require precise synchronisation to external signals – laser pulses, chopper signals, accelerator bunch crossings, or ancillary detectors. This is exactly where PicoTDC is integrated: as a companion timing system that timestamps external trigger signals with sub-5 ps precision, enabling cross-correlation of Timepix3 hit data with global event timing.

The following ASI detector systems are available with PicoTDC integration:

- **LynX:** Timepix3-based detector family for X-ray detection. Used in synchrotron beamlines, XPS, and X-ray scattering experiments.
- **Chronos Hyperion, Phoebe, Telesto:** Timepix3-based optical camera systems for photon, ion, and neutron detection (direct or with MCP/scintillator). Covers VMI, quantum optics, neutron TOF, and COLTRIMS.
- **CheeTah:** Direct electron detector family for transmission electron microscopy (TEM). Used in 4D-STEM, UTEM, and electron diffraction (3D-ED).
- **FeliS:** Electron detector for scanning electron microscopy (SEM). Used in time-resolved SEM and 4D-STEM-in-SEM applications.

For all ASI Timepix3 detectors, PicoTDC provides high accuracy timing information of external inputs and injects them directly into the Timepix3 datastream, evolving the event-based detector into one with lab-grade time-tagging precision that could even compete with standalone TDC’s.

3. Time-Resolved Applications

The following sections describe major scientific application domains that benefit from PicoTDC-grade timing in combination with ASI Timepix3 detectors. Each section explains the physical measurement challenge, the role of the Timepix3 detector, and the specific advantage provided by sub-5 ps timing.

3.1 Velocity Map Imaging (VMI) and Ion/Electron Time-of-Flight

Velocity Map Imaging is a cornerstone technique of gas-phase reaction dynamics, enabling the reconstruction of the full three-dimensional momentum distribution of ions or electrons produced by laser-induced ionisation or photodissociation. In a VMI apparatus, charged particles are accelerated through an electrostatic lens system and projected onto a position-sensitive detector, typically a microchannel plate (MCP) coupled to a phosphor screen or directly to a position sensitive detector (e.g. delay line detectors). The arrival position encodes the transverse momentum; the time-of-flight (TOF) encodes the longitudinal momentum and, critically, the particle mass via m/z.

With ASI's Chronos series (successor of the TPX3CAM) behind an MCP/P47 screen, each ion hit is timestamped at the Timepix3 pixel level with ~5-10 ns resolution. This is sufficient for many VMI measurements. However, in experiments involving multiple co-fragments from the same ionisation event such as Coulomb explosion imaging (CEI), ion-pair imaging, or coincidence VMI (COVI), the ability to tag each ion hit relative to the ionising laser pulse with sub-5 ps precision dramatically improves the fidelity of coincidence assignments and eliminates ambiguity between adjacent TOF peaks.

PicoTDC timestamps the MCP tapout signals (fast analogue pulses from the MCP anode rings) and the laser sync pulse simultaneously, providing a global time reference for each laser shot. Compared to the ~100 ps resolution of conventional discriminator-plus-TDC solutions, the 3.3 ps RMS of PicoTDC improves the effective TOF mass resolution by ~30×, enabling the resolution of ion species that differ by a single atomic mass unit in short flight tubes.

Additional VMI-related capabilities enabled by PicoTDC include: electron TOF spectroscopy for photoelectron angular distribution (PAD) measurements with circularly polarised light; Photoelectron-Photoion Coincidence (PEPICO) spectroscopy; and COLTRIMS-like ion-electron coincidence measurements.

3.2 Ultrafast Transmission Electron Microscopy (UTEM)

Ultrafast Transmission Electron Microscopy (UTEM) – also referred to as Ultrafast Electron Microscopy (UEM) – is a pump-probe technique in which ultrashort laser pulses generate electron bunches that probe a sample at a precisely controlled delay after an excitation event. By varying this delay across many shots and reconstructing the evolving diffraction pattern or real-space image, researchers can capture nanoscale structural dynamics on timescales from femtoseconds to nanoseconds, resolving phenomena such as phase transitions, plasmon dynamics, phonon propagation, and magnetic switching [4].

The CheeTah detector from ASI – a direct electron detector based on Timepix3 – is optimised for UTEM applications, using a two channel FPGA-based TDC for synchronization with the primary laser or additional detectors, but the on-board TDC was limited to time bins of 260 picoseconds.

PicoTDC extends the timing system of the UTEM by providing precise cross-correlation between the probe electron arrival, the pump laser trigger, and any ancillary RF cavity or photoemission gun signals. This is essential for correcting laser-to-electron jitter, one of the primary resolution limits in UTEM systems. By measuring the arrival time of each laser sync pulse with 3.3 ps accuracy, PicoTDC enables real-time jitter tagging and post-processing correction, recovering temporal resolution that would otherwise be lost to timing instability.

Multi-pump, multi-probe, and multi-device correlation schemes are becoming increasingly common in the study of coupled electronic and structural dynamics. Such experiments benefit directly from PicoTDC's 5-channel simultaneous timing capability.

3.3 Imaging Mass Spectrometry

Imaging Mass Spectrometry (IMS) maps the spatial distribution of molecular species across a sample surface by correlating ion signal with lateral position and mass-to-charge ratio. In secondary ion mass spectrometry (SIMS) and laser desorption/ionisation (LDI) variants, the mass dimension is encoded by time-of-flight: ions generated at the sample surface are accelerated through a field-free drift region and arrive at the detector at a time proportional to the square root of their m/z.

A Timepix3-based ion microscope mass spectrometer has been demonstrated in the literature [5], using Timepix3's 1.56 ns TOF resolution to resolve ion species across the full mass range. However, for high-mass analytes (proteins, lipid clusters, synthetic polymers) where adjacent peaks in the m/z spectrum are closely spaced, and for experiments at long flight tubes where TOF peaks are narrow, a finer timing resolution is required to avoid peak overlap and improve mass accuracy.

PicoTDC, integrated with the Chronos series, provides a factor of ~500 improvement in timing resolution over conventional electronics, enabling ultra-high mass resolution in compact TOF tubes. This is particularly valuable for lipidome imaging in tissue samples, where hundreds of species must be simultaneously resolved, and for metrology applications where mass accuracy at the sub-ppm level is required.

3.4 Time-Resolved X-ray Photoelectron Spectroscopy (TR-XPS)

X-ray Photoelectron Spectroscopy (XPS) probes the electronic structure of materials by measuring the kinetic energy of photoelectrons ejected from a sample surface upon X-ray irradiation. Time-resolved XPS (TR-XPS) extends this to ultrafast dynamics by using pulsed X-ray sources such as free-electron lasers (FELs) or synchrotron storage rings operated in timing mode to track transient electronic states, charge transfer, and bond-breaking events with elemental and chemical-state specificity.

ASI's LynX and Chronos detectors are used in synchrotron and FEL XPS beamlines where position-resolved electron detection is required. Critically, TR-XPS experiments at FEL sources demand timing synchronisation between the FEL X-ray pulse arrival and the optical pump laser at the picosecond level – a requirement directly addressed by PicoTDC.

In a recent demonstration of TR-XPS at the S 2p edge of CS_2, the experiment required pump-probe delay accuracy of better than 10 ps to resolve ultrafast dynamics in a photoexcited molecule [6]. PicoTDC's 3.3 ps single-shot resolution, used to timestamp both the FEL arrival monitor and the optical laser sync, would provide threefold margin over this requirement while also enabling real-time timing diagnostics that identify X-ray pulse-arrival jitter from shot to shot.

More broadly, XCPS (X-ray coincidence photoelectron spectroscopy) and time-resolved X-ray photon correlation spectroscopy (XPCS) at synchrotrons will benefit from the global timing reference that PicoTDC provides relative to the accelerator bunch structure.

3.5 Quantum Optics: Hong-Ou-Mandel, QKD, and Photon Correlation

Quantum optics experiments rely fundamentally on the ability to detect and timestamp single photons with sufficient temporal precision to observe interference effects, enforce coincidence windows, and characterise the quantum state of light. Three specific capabilities drive the timing requirements in this domain.

Hong-Ou-Mandel Interference

The Hong-Ou-Mandel (HOM) effect [7] in which two indistinguishable photons entering a 50:50 beam splitter simultaneously will always exit together in the same output port, is the canonical demonstration of photon indistinguishability and forms the basis of linear optical quantum computing, quantum teleportation, and Bell-state measurements. The visibility of the HOM dip (the characteristic reduction in coincidence rate as the path length difference is scanned through zero) degrades if the coincidence window is wider than the photon coherence time.

A direct demonstration of HOM interference using a TPX3CAM was published in 2020 [8], counting Hong-Ou-Mandel bunched photons spatially and temporally resolved across the detector. PicoTDC can extend this capability by providing an external timing reference with 3.3 ps RMS accuracy for the laser sync pulse. This could enable coincidence time windows below 20 ps – sufficient to observe HOM interference from spectrally broad photon pairs that require sub-coherence-time resolution.

Quantum Key Distribution (QKD)

In time-bin QKD protocols, information is encoded in the arrival time of single photons within a narrow temporal window. The security of the protocol depends partly on the ability to precisely distinguish early and late time bins. PicoTDC's multi-channel capability (64 channels) would allow simultaneous timestamping of multiple single-photon detector (SPAD or SNSPD) outputs with a common timing reference, supporting high-speed QKD receiver designs and characterisation of channel timing properties.

Photon Correlation Spectroscopy and g(2) Measurements

The second-order photon correlation function $g(2)(\tau)$ – the Hanbury Brown and Twiss observable – characterises the photon statistics of a light source: sub-Poissonian ($g(2)(0) < 1$) for single-photon emitters, Poissonian for coherent light, and super-Poissonian for thermal or bunched light. Measuring g(2) with high temporal resolution requires picosecond-precision timing of photon arrival times from two detectors. PicoTDC could enable g(2) measurements with correlation time resolution of 3.3 ps, extending the technique to emitters with very short coherence times including plasmonic nanoemitters and defects in 2D materials.

3.6 Neutron Time-of-Flight Spectroscopy

Neutron time-of-flight (TOF) spectroscopy determines the kinetic energy and thus the wavelength of neutrons by measuring the time elapsed between the neutron source pulse and detection. At spallation sources such as the European Spallation Source (ESS, Lund), the Spallation Neutron Source (SNS, Oak Ridge), or J-PARC (Tokai), a pulsed proton beam produces a burst of neutrons with a broad energy spectrum; the TOF across a fixed flight path encodes energy. High-resolution neutron spectroscopy requires timing accuracy at the microsecond level over flight paths of 10–100 m, easily achievable with conventional electronics. However, correlating neutron events with specific gamma-ray or ancillary detector signals in coincidence experiments (e.g., fission (n,γ) cross-section measurements, or neutron-gamma discrimination) will benefit from picosecond-precision timing of the reference pulse or correlation of neutron and gamma detectors.

ASI's Chronos series is well-established in neutron science: Timepix-based detectors have measured fast neutrons at Los Alamos LANSCE using TOF techniques [9], and the Chronos neutron camera is deployed at ESS and ISIS for 2D neutron imaging. PicoTDC would providesthe high-accuracy global timestamp required to synchronise Chronos neutron events with the T0 spallation pulse, beam monitor signals, and coincidence gamma detectors, improving the precision of neutron spectroscopy and could enable new coincidence-based neutron science.

3.7 COLTRIMS / Reaction Microscopy

Cold Target Recoil-Ion Momentum Spectroscopy (COLTRIMS) is the most complete tool available for studying atomic and molecular fragmentation dynamics [10]. In a COLTRIMS apparatus, an internally cold target gas jet intersects an ion, electron, or photon beam. All ionic and electronic fragments from a single collision event are guided by weak electric and magnetic fields to position-sensitive delay-line detectors. By measuring the impact position and time-of-flight of every fragment, the full 3D momentum vector of each particle is reconstructed, yielding a kinematically complete picture of the collision.

The TOF discrimination between different fragment masses in COLTRIMS is limited by the timing resolution of the delay-line detector readout electronics. In a typical 20 cm flight tube operating at a few tens of V/cm extraction field, mass-adjacent ion species (e.g., N+ vs O+ from air contamination, or isotopic variants) have TOF differences of only a few hundred picoseconds. A TDC resolution of 3.3 ps RMS provides a mass resolving power improvement of ~30× compared to a 100 ps TDC, enabling clean separation of closely spaced mass channels without lengthening the flight tube.

Chronos Hyperion detectors or MCP/Timepix3 can replace the conventional delay-line detector at one of the spectrometer arms. With PicoTDC providing the global timing reference, a hybrid COLTRIMS-Timepix3 instrument would gain the advantage of spatially-resolved 2D imaging on the detector face combined with PicoTDC-accuracy TOF on the MCP tapout signal.

3.8 Additional Emerging Applications

Beyond these primary application domains described above, several emerging areas stand to benefit from PicoTDC integration, not only with ASI Timepix3 detectors, but also in combination with other technologies:

- Superconducting Nanowire Single-Photon Detectors (SNSPDs): SNSPDs generate extremely sharp electrical pulses (~100 ps FWHM jitter) upon photon detection. Timestamping SNSPD arrays with PicoTDC preserves the intrinsic timing resolution of the detector, enabling photon correlation and QKD applications at telecom wavelengths.
- Time-Resolved Raman and CARS Spectroscopy: Pump-probe coherent anti-Stokes Raman spectroscopy (CARS) requires precise delay timing between pump, Stokes, and probe pulses at the sub-picosecond level. PicoTDC provides the timing reference for multi-pulse synchronisation across multiple laser systems.
- Laser Ranging and LiDAR: High-precision LiDAR systems for metrology, autonomous navigation, and atmospheric sensing require picosecond-resolution TOF measurement of laser return pulses. PicoTDC's 3.3 ps resolution corresponds to a range precision of ~0.5 mm (round-trip), competitive with the best single-photon avalanche diode (SPAD) array systems.
- Time-Resolved Cathodoluminescence in SEM: FeliS, ASI's SEM detector, combined with PicoTDC and a pulsed electron beam, can enable time-resolved cathodoluminescence (TRCL) imaging with sub-10 ps gating, relevant for characterising defect dynamics, carrier lifetimes, and optical cavity modes in semiconductor nanostructures.
- Photonic Quantum Computing: Circuit-based photonic quantum processors (e.g., QuiX Quantum-style approaches) rely on detecting single-photon events across many modes with precise coincidence windows. PicoTDC's 64-channel simultaneous timestamping is directly applicable to monitoring photonic circuit outputs with the temporal resolution required to enforce coincidence in boson sampling and cluster-state generation experiments.

4. Application–Product Matrix

Table 2 provides a consolidated overview of the primary application domains addressed in this white paper, the specific timing requirement each imposes, the recommended ASI detector, and the key benefit delivered by PicoTDC integration.

Application Domain	Key Timing Requirement	ASI Detector	PicoTDC Benefit
VMI / Ion TOF	< 10 ps TOF discrimination	Chronos (TPX3CAM)	30× mass resolution vs. 100 ps TDC
UTEM / USEM	Pump-probe jitter < 5 ps	CheeTah	Shot-by-shot jitter tagging & correction
Imaging Mass Spectrometry	Sub-ns TOF resolution at high m/z	Chronos	Ultra-high mass resolution in compact tubes
TR-XPS / XPCS	FEL sync < 10 ps	LynX	Real-time FEL timing diagnostics
Hong-Ou-Mandel / QKD	Coincidence window < 20 ps	Chronos	Sub-coherence-time photon correlation
Neutron TOF	Sub-10 ps reference pulse sync	Chronos (neutron)	Precision T0 tagging at spallation sources
COLTRIMS	< 10 ps mass channel separation	Chronos	Mass-adjacent fragment discrimination

Table 2. Application–product matrix for PicoTDC-enabled ASI Timepix3 detectors

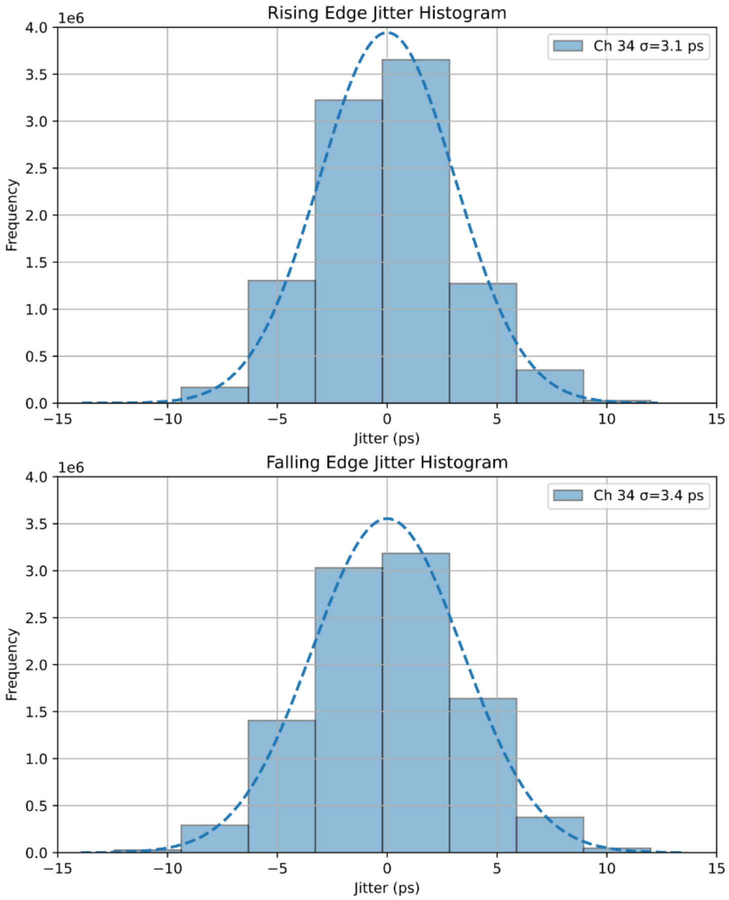
5. Performance Results

5.1 Timing Jitter Characterisation

ASI has characterised the timing jitter of PicoTDC implementation using a 1 MHz clock input from a high-accuracy clock generator chip. Timing jitter is expressed as Time Interval Error (TIE) with moving-average detrending to remove low-frequency drift and isolate the true random jitter component.

The measured TIE distribution is Gaussian with a standard deviation of 3.3 ps RMS, confirming the specification across all 64 channels. The histogram of TIE values shows a sharp peak width consistent with this figure, with no evidence of multi-modal distributions or systematic offsets that would indicate non-linearity in the DLL interpolator. The on-chip per-channel calibration feature reduces this to 1.35 ps RMS for a single optimised channel – a figure competitive with the intrinsic jitter of the best laboratory photon timing modules.

It is important to note that the achievable system-level timing resolution in a complete experiment is determined by the convolution of PicoTDC jitter, the detector signal rise time, the discriminator threshold jitter (timewalk), and the stability of the external clock reference. For MCP-based detectors, the dominant contribution is typically the MCP pulse rise time, which is corrected by timewalk calibration. For fast SPAD or SNSPD detectors, the system jitter is dominated by PicoTDC itself at 3.3 ps RMS.



6. Conclusions

The CERN PicoTDC represents a step change in the timing precision available to scientific instrumentation outside of high-energy physics. Its 3.3 ps single-shot RMS resolution, 64-channel simultaneous operation, and sustained throughput of 320 Mhit/s per channel address the timing bottleneck that has limited a broad range of time-resolved experimental techniques.

Integrated with ASI's Timepix3-based detector family PicoTDC transforms these detectors from high-performance event-mode detection systems into precision timing instruments capable of anchoring their hit data to global experimental time axes with picosecond accuracy. This combination would enable:

- VMI and ion TOF experiments with ~30× improved mass resolving power
- UTEM pump-probe measurements with shot-by-shot laser jitter correction
- Imaging mass spectrometry at ultra-high mass resolution in compact flight tubes
- TR-XPS and XPCS at free-electron laser facilities with real-time timing diagnostics
- Wide-field FLIM and STED gating with sub-5 ps instrument response functions
- Quantum optics experiments such as HOM interference, QKD, and g(2) spectroscopy with coincidence windows below 20 ps
- Correlated Neutron-Gamma detection experiments or highly precise T0 timing
- COLTRIMS measurements with sharper mass channel separation

PicoTDC technology is available today through ASI's detector product lines. Scientists interested in exploring how PicoTDC can benefit their specific measurement challenge are encouraged to contact ASI's applications team.

Want to know how PicoTDC can help in your lab?

Contact ASI's applications team to discuss your timing requirements and find the right Timepix3 detector configuration.

www.amscins.com · hello@amscins.com

7. References

[1] Agapopoulou, C. et al. (2023). "PicoTDC: a flexible 64 channel TDC with picosecond resolution." JINST 18, P07012. DOI: 10.1088/1748-0221/18/07/P07012

[2] CERN EP News (2023). "64 channel picosecond time resolution instrumentation in 25 milligrams of silicon." ep-news.web.cern.ch

[3] CERN Knowledge Transfer. "PicoTDC." kt.cern/technologies/picotdc; picotdc.web.cern.ch

[4] Zhu, Y. et al. (2023). "Development and applications of ultrafast transmission electron microscopy." Microscopy 72(4):287–307. DOI: 10.1093/jmicro/dfad011

[5] Nyadong, L. et al. (2022). "Ion Microscope Imaging Mass Spectrometry Using a Timepix3-Based Optical Camera." J. Am. Soc. Mass Spectrom. DOI: 10.1021/jasms.2c00223

[6] Squibb, R.J. et al. (2023). "Time-Resolved X-ray Photoelectron Spectroscopy: Ultrafast Dynamics in CS2 Probed at the S 2p Edge." J. Phys. Chem. Lett. DOI: 10.1021/acs.jpclett.3c01447

[7] Hong, C.K., Ou, Z.Y. & Mandel, L. (1987). "Measurement of subpicosecond time intervals between two photons by interference." Phys. Rev. Lett. 59(18):2044–2046.

[8] Ianzano, C. et al. (2020). "Counting of Hong-Ou-Mandel Bunched Optical Photons Using a Fast Pixel Camera." Sensors 20(12):3475. DOI: 10.3390/s20123475

[9] Tremsin, A.S. et al. (2014). "Time-of-flight measurement of fast neutrons with Timepix detectors." Nucl. Instrum. Methods A. doi.org/10.1016/j.nima.2013.12.028

[10] Dörner, R. et al. (2000). "Cold Target Recoil Ion Momentum Spectroscopy: a 'momentum microscope' to view atomic collision dynamics." Phys. Rep. 330:95–192.